Disclaimer

The following presentation (with minor modifications) was provided to the Salton Sea Science Committee at its meeting on June 11, 2018, for informational purposes. Its posting here does not constitute endorsement of any kind by the State of California or the Science Committee.

Salton Sea Water Demand Estimation

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Salton Sea Management Program Science Committee

June 11, 2018*

*Updated with two additional habitat figures, and explicit estimation of seepage losses.

PLANTIERRA

Water Dependent Habitat

- Develop framework to quickly estimate water demand based on:
  - Species focus and prioritization
  - Defined habitat criteria for each species
  - Scale of habitat units
  - Climatic and water supply salinity scenarios
- Consider need for applied water to:
  - Replace what is consumed by plants, directly evaporated (evapotranspiration, or ET), or seeping downward or through berms
  - Flush salts through habitat units (outflow can be re-used)
- No explicit assessment of trace elements' potential ecotoxicity

Approach

- Structured analysis with explicit but changeable inputs
- User defines:
  - Scale of habitat facilities
  - Relative emphasis among species considered
- Demand estimated for two climatic scenarios (mean, dry)
- Ecologists who developed habitat parameters:
  - Dave Shuford, Point Blue
  - Dan Cooper, Cooper Ecological
- Work supported by California Audubon

Species of Interest

- Selected to represent:
  - Main bird guilds at the Salton Sea
  - Species that were or are highly concentrated at the Salton Sea
  - Species vulnerable to changes at the sea (e.g., loss of fish), or are at-risk in California &/or the Western U.S.

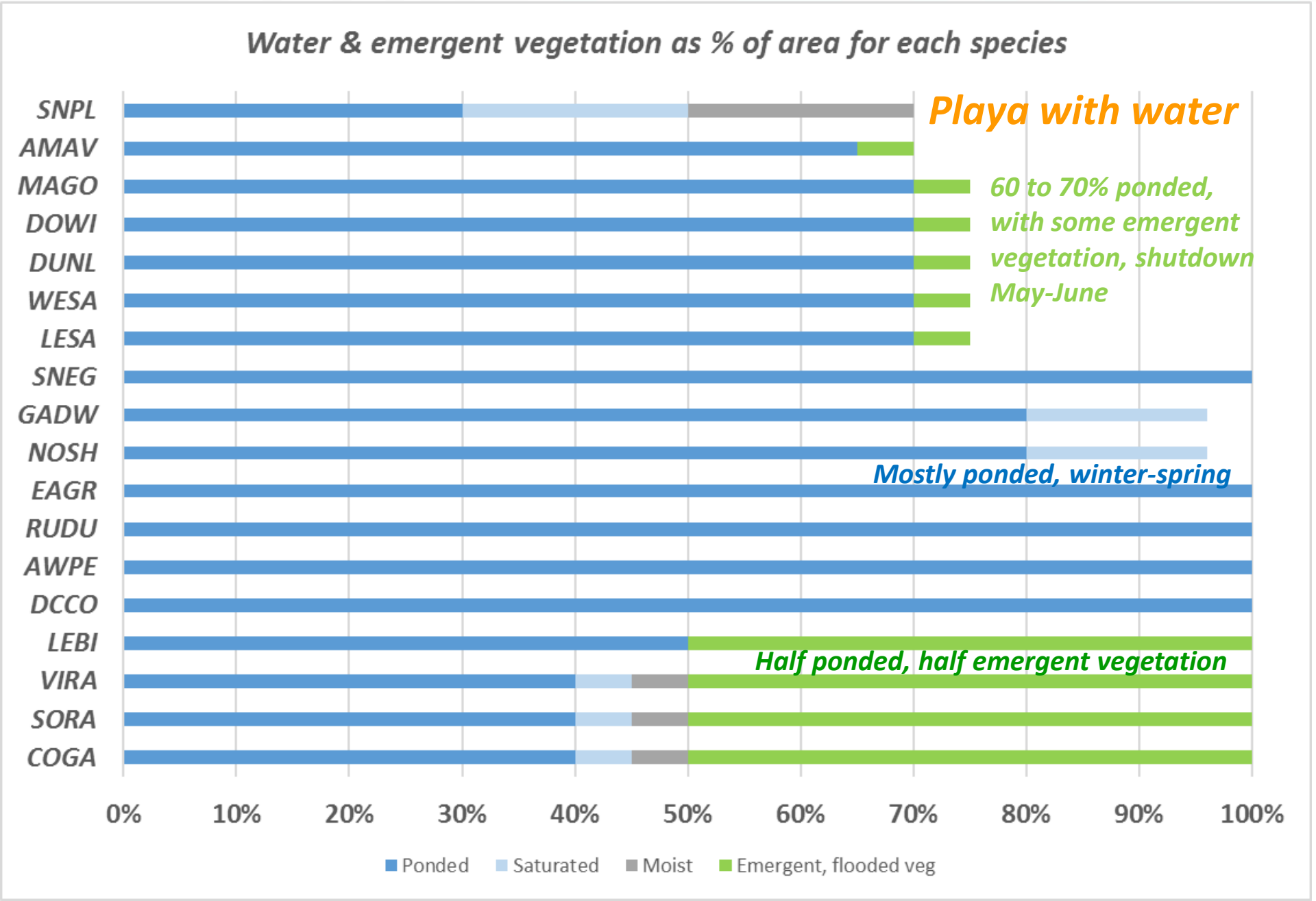
Species List

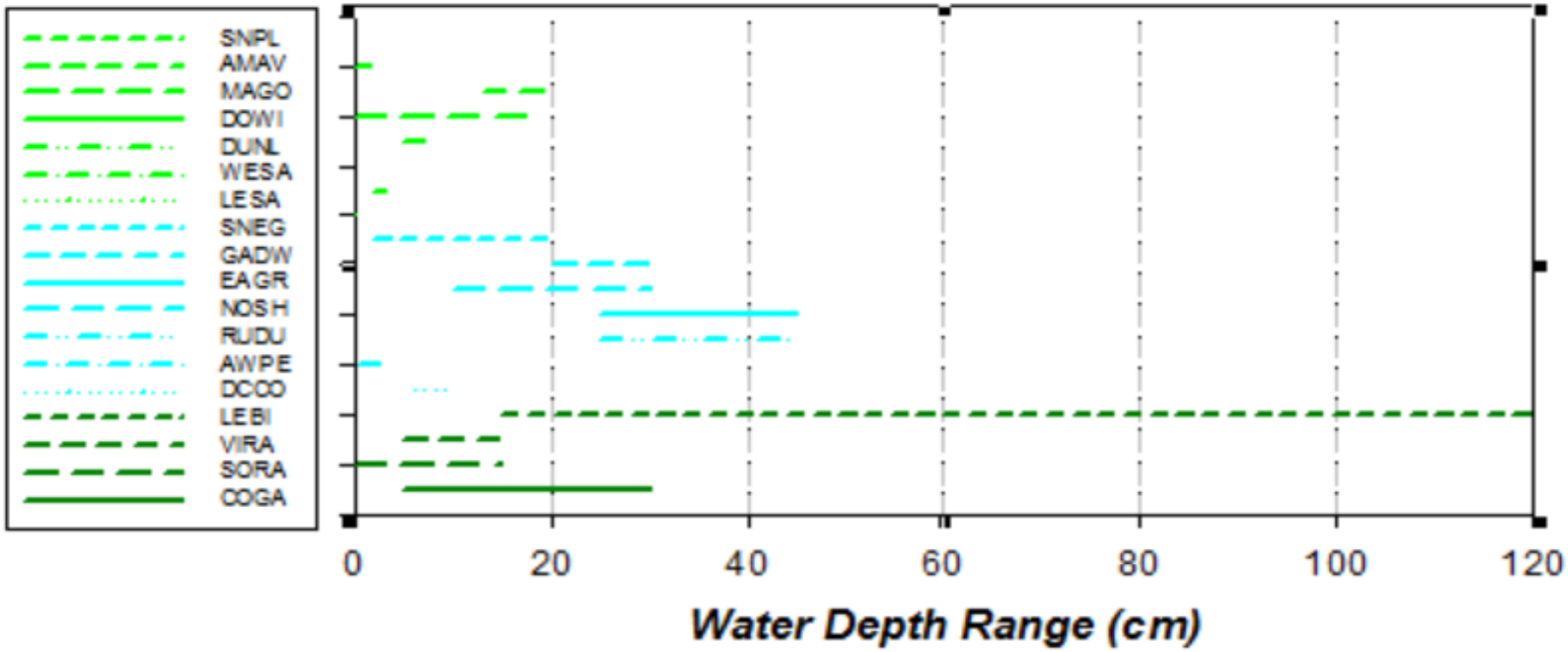
Habitat type		Common name
Playa with water	SNPL	Snowy Plover
60 to 70% ponded, with some emergent vegetation, shutdown May-June	AMAV	American Avocet
	MAGO	Marbled Godwit
	DOWI	Dowitcher (2 spp., shorebird)
	DUNL	Dunlin
	WESA	Western Sandpiper
	LESA	Least sandpiper

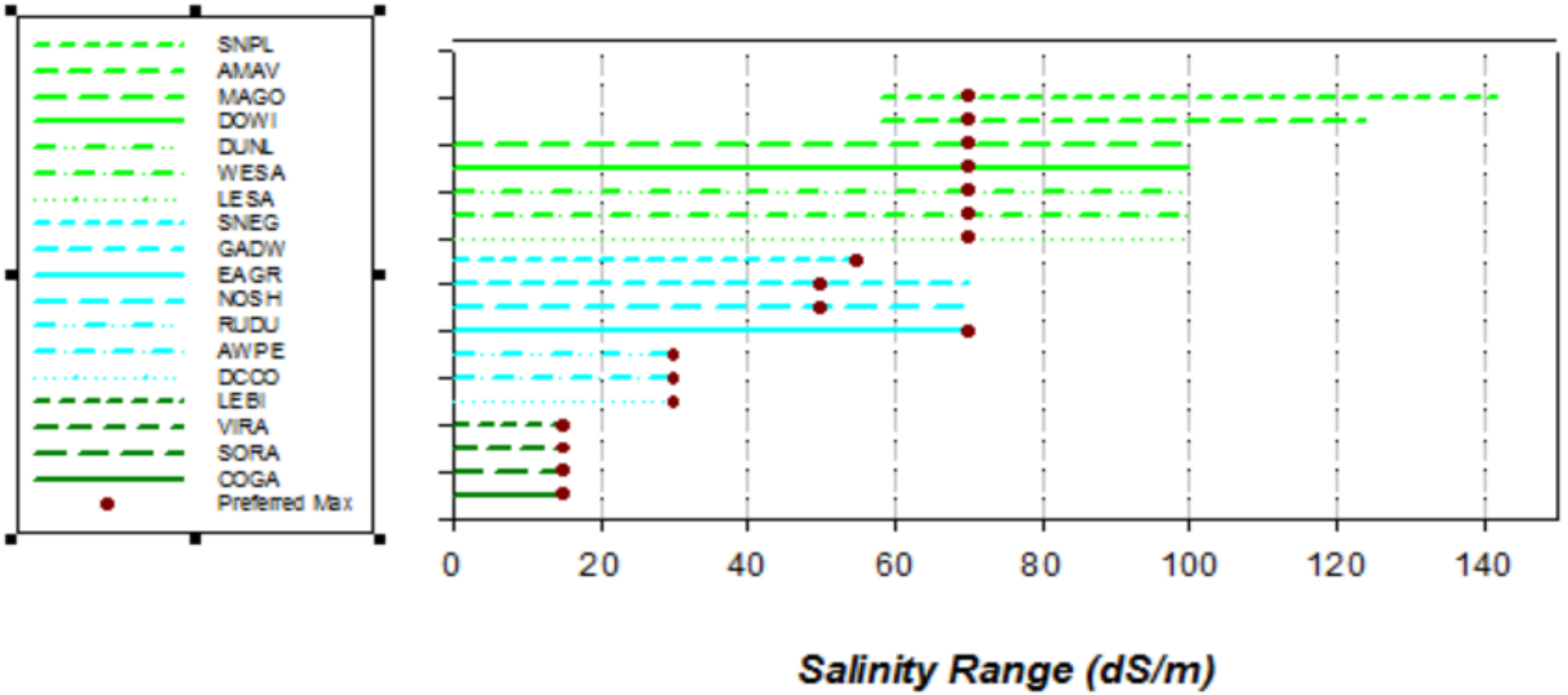
Habitat type		Common name
Mostly ponded, winter-spring	SNEG	Snowy Egret
	GADW	Gadwall
	NOSH	Northern Shoveller
	EAGR	Eared Grebe
	RUDU	Ruddy Duck
	AWPE	American White Pelican
	DCCO	Double crested cormorant
Half ponded, half emergent vegetation	LEBI	Least Bittern
	VIRA	Virginia Rail
	SORA	Sora
	COGA	Common Gallinule

Water Application Months

Species	Period	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SNPL	Jan-Dec												
AMAV	Aug-Apr												
MAGO	Jan-Dec												
DOWI	Jan-Aug												
DUNL	Jan-Dec												
WESA	Jul-Apr												
LESA	Oct-May												
SNEG	Dec-May												
GADW	Jul–Apr												
NOSH	Nov–May												
EAGR	Jan–Dec												
RUDU	Jul–Apr												
AWPE	Jul–May												
DCCO	Oct-May												
LEBI	Jul–May												
VIRA	Jul–Apr												
SORA	Jul-Apr												
COGA	Jan–Dec												

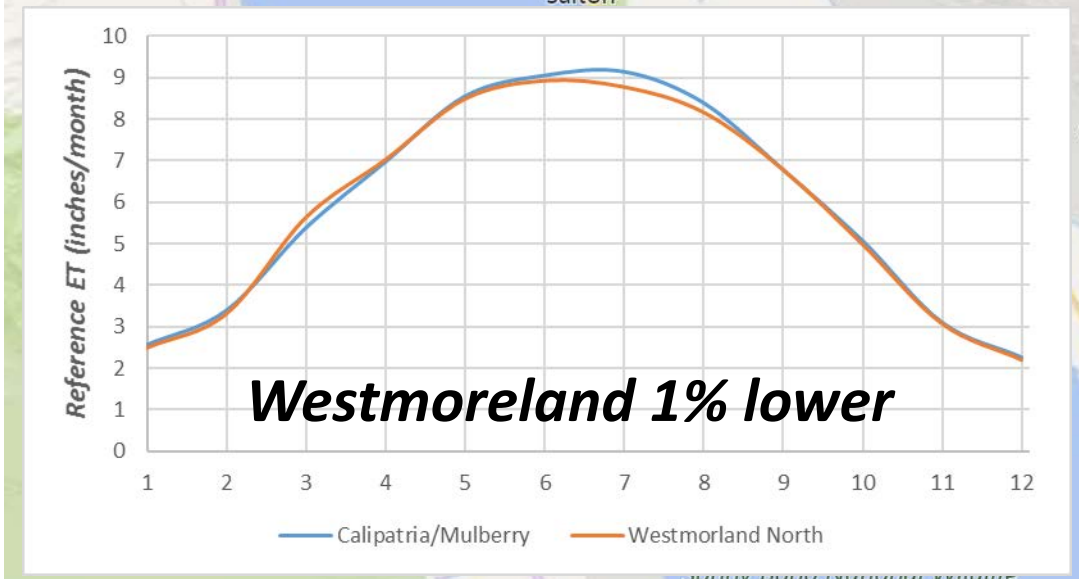

Water & emergent vegetation as % of area for each species
SNPL
AMAV
MAGO
DOWI
DUNL
WESA
LESA
SNEG
GADW
NOSH
EAGR
RUDU
AWPE
DCCO
LEBI
VIRA
SORA
COGA
Playa with water
60 to 70% ponded, with some emergent vegetation, shutdown May-June
Mostly ponded, winter-spring
Half ponded, half emergent vegetation
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Ponded
Saturated
Moist
Emergent, flooded veg


SNPL
AMAV
MAGO
DOWI
DUNL
WESA
LESA
SNEG
GADW
EAGR
NOSH
RUDU
AWPE
DCCO
LEBI
VIRA
SORA
COGA
0
20
40
60
80
100
120
Water Depth Range (cm)


SNPL
AMAV
MAGO
DOWI
DUNL
WESA
LESA
SNEG
GADW
EAGR
NOSH
RUDU
AWPE
DCCO
LEBI
VIRA
SORA
COGA
Preferred Max
0
20
40
60
80
100
120
140
Salinity Range (dS/m)

ETAW = ETo * Kc - Precip * Eff precip

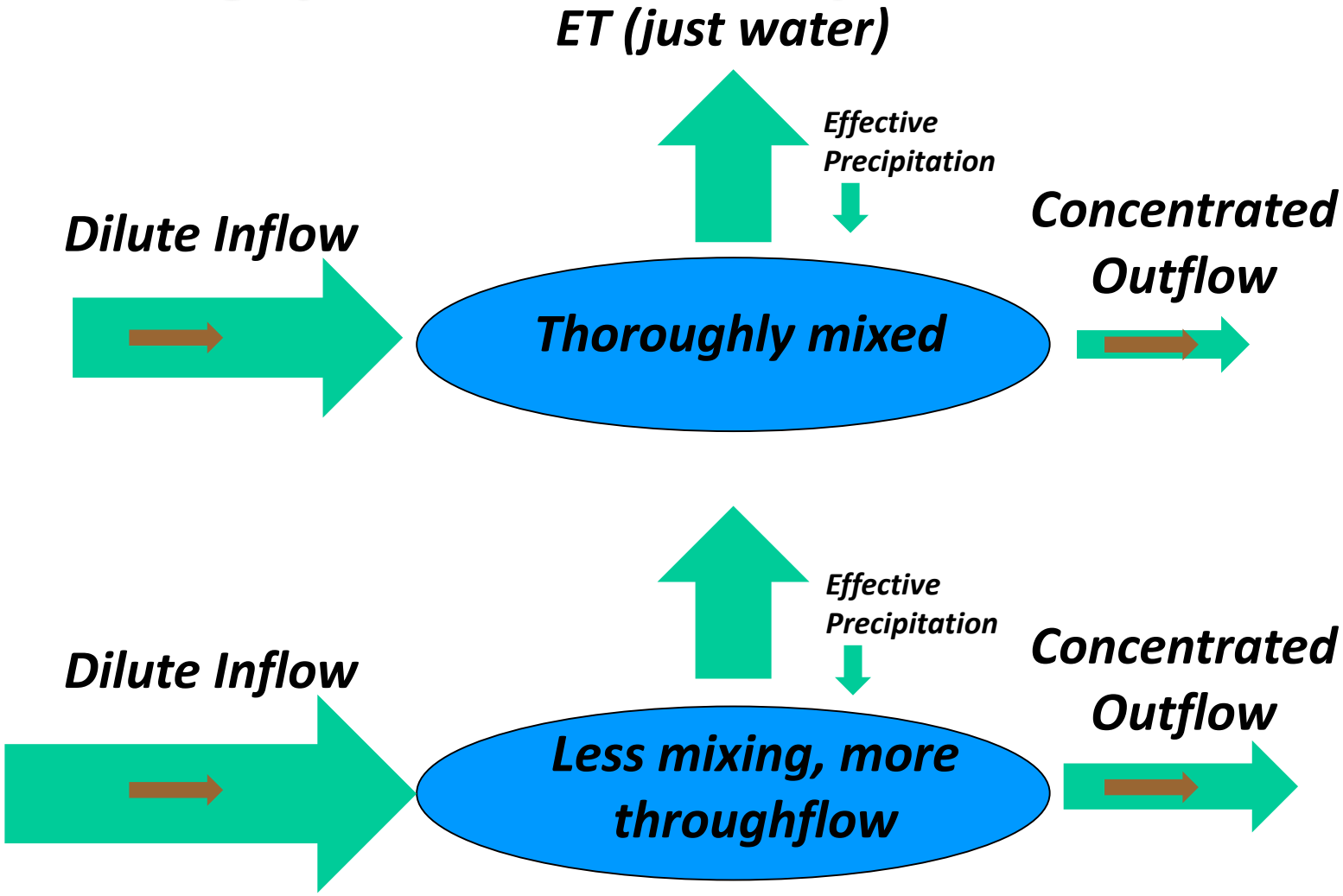
Sources of climatic information: CIMIS Data



ETAW = ETo * Kc - Precip * Eff precip

Parameter	Condition			Annual
Eto	Mean			71
Eto	75th pctile			73
Eto	95th pctile			76
Precip	Mean			3.2
Precip	25th pctile			1.6
Precip	5th pctile			0.2
Eff precip	0.5			
ETAW	Mean, mean	Emergent vegetation		91
ETAW	95th, 25th	Emergent vegetation		99
ETAW	Mean, mean	Ponded areas		82
ETAW	95th, 25th	Ponded areas		86
ETAW	Mean, mean	Other wet areas		84
ETAW	95th, 25th	Other wet areas		91

Salt in = Salt out (at steady state)
Throughflow volume depends on mixing



Tools for estimating maximum seepage potential

Potential vertical seepage rate* lookup

USDA texture of soil:	Clay
Porosity (%)	48%
Hydraulic conductivity (cm/s)	1.28E-04
Potential vertical seepage (inches/year)	768

Potential lateral seepage rate* calculator:

USDA texture of berm and underlying material:	Silt loam
Porosity (%)	49%
Hydraulic conductivity (cm/s)	7.20E-04
Depth of seepage face (f)	3
Potential lateral seepage (cfs/1000 feet)	0.03

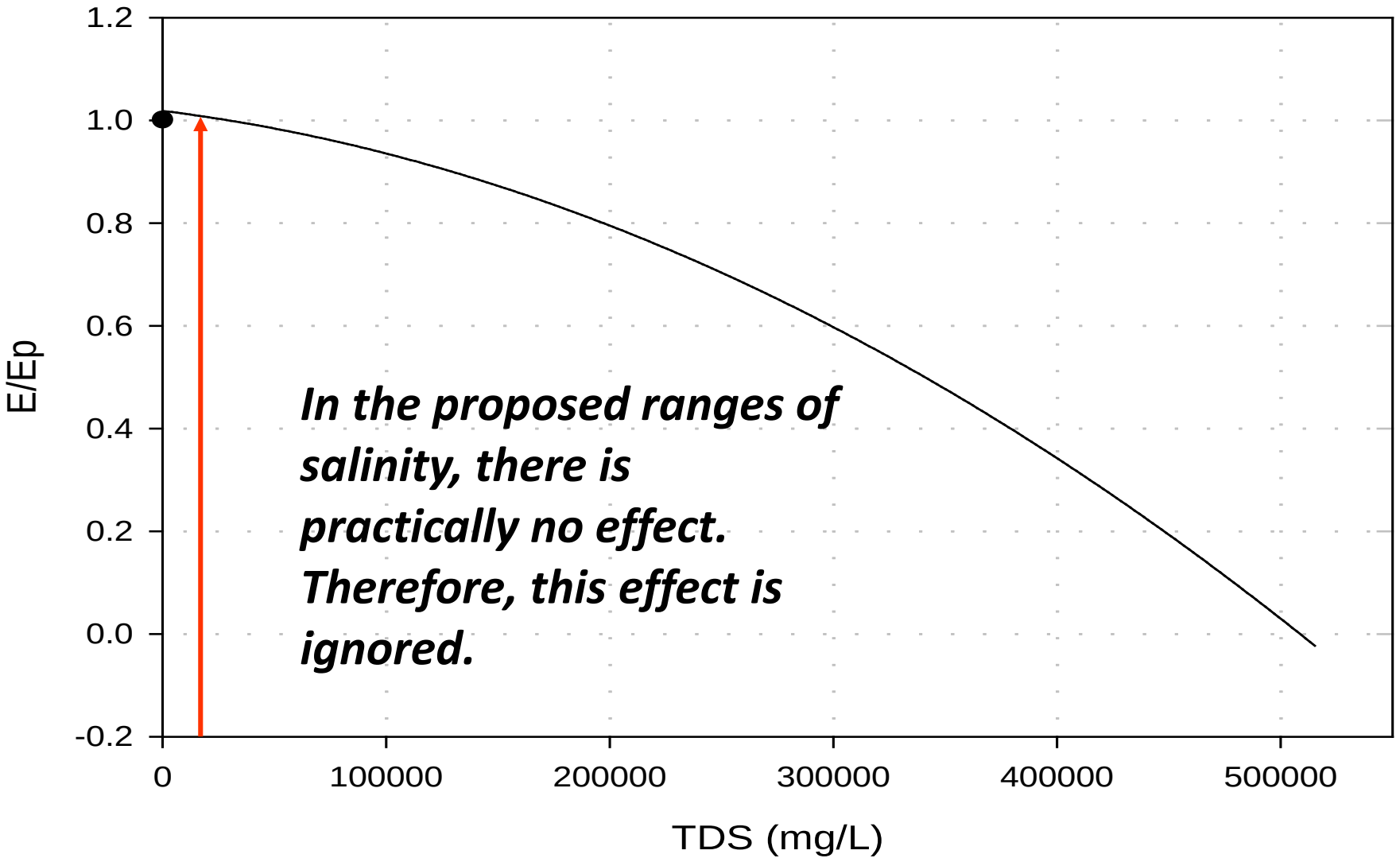
*Note that vertical seepage may be less than the saturated hydraulic conductivity due to compaction, restrictive soil layers, or perched groundwater conditions.

Lateral seepage may also be lower than the calculated value, which is for non-engineered, uncompacted soil.

Explicit, user-controlled calculation of seepage, which is allocated equitably among habitat types

Seepage options and results. User supply fields shown in red.		
Vertical rate of seepage (saturated & ponded):	12	inches/year
Estimated vertical seepage from wetted area:	*567*	*acre-feet/year*
Number of non-contiguous blocks:	1	
Lenth:width of blocks:	4	ft/ft
Perimeter length:	29,516	feet
Proportion with adjacent saturation:	80%	
Proportion of year saturated:	75%	
Lateral seepage rate (see calculator):	0.03	cfs/1000 feet
Estimated lateral seepage:	385	*acre-feet/year*
Estimated total seepage:	***952***	***acre-feet/year***

Adjustment of ET for Salinity



Water Demand = Consumptive Use (ETAW) + Through Flow + Seepage (downward and laterally)

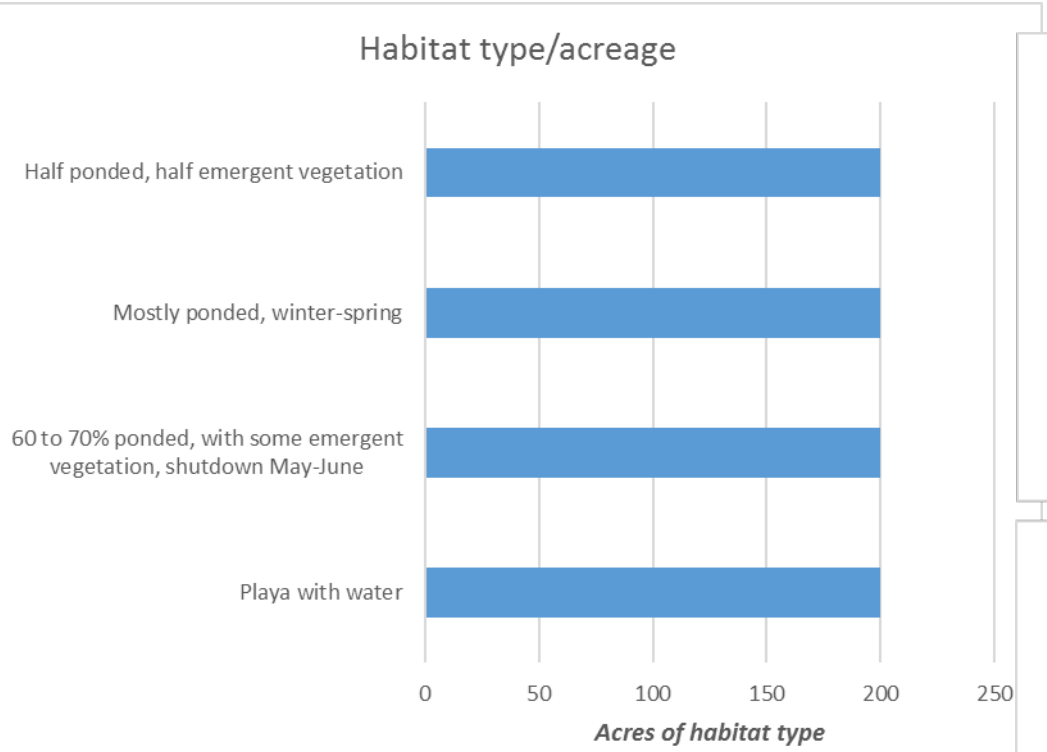
8 such tables:

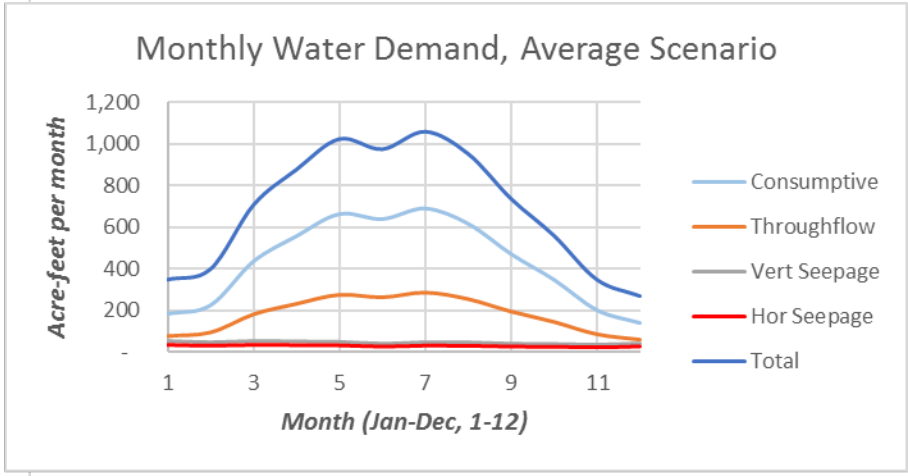
Mean & drought, consumptive use, throughflow, & total (6)

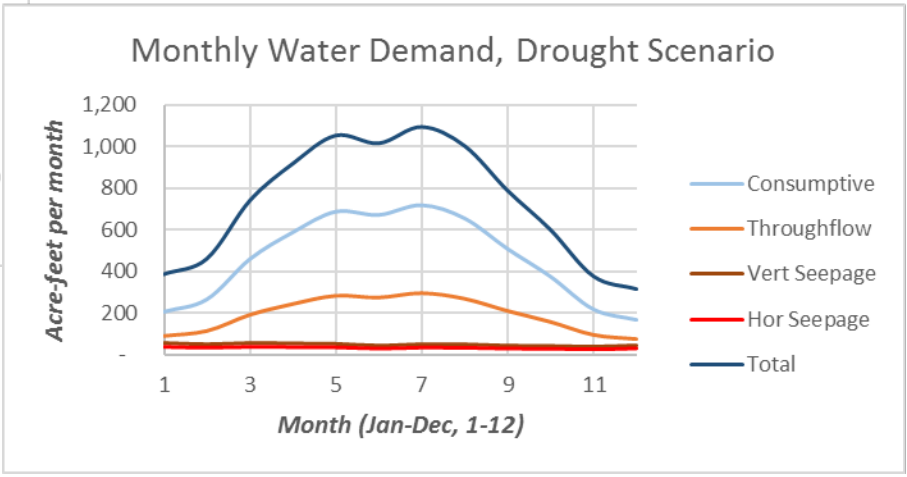
Downward and lateral seepage (2)

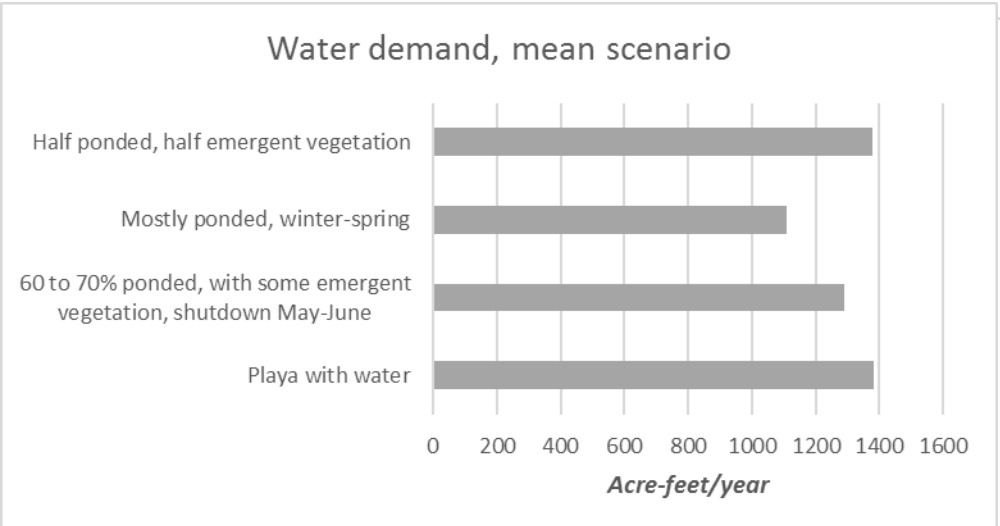
									Total	
	(acres)	*(acre-feet/year)*	*(%)*	*Common*	*G/S*		*(%)*	*(f/y)*		*(acres)*
Playa with water	200	1384	0%	***Snowy Plover***	SNPL	M	100%	6.9	1,384	200
60 to 70% ponded, with some emergent vegetation, shutdown May-June	200	1292	0%	***American Avocet***	AMAV	M	50%	6.5	648	100
				Marbled Godwit	MAGO	L/M	10%	6.4	129	20
				Dowitcher (2 spp., shorebird)	DOWI	L/M	10%	6.7	135	20
				Dunlin	DUNL	L	5%	5.3	53	10
				Western Sandpiper	WESA	L/M	10%	6.7	135	20
				Least sandpiper	LESA	L/M	15%	6.4	193	30
Mostly ponded, winter-spring	200	1108	0%	***Snowy Egret***	SNEG	M	10%	6.8	137	20
				Gadwall	GADW	L	5%	5.0	50	10
				Northern Shoveller	NOSH	L/M	5%	6.3	63	10
				Eared Grebe	EAGR	H	20%	4.2	169	40
				Ruddy Duck	RUDU	H	20%	4.2	169	40
				American White Pelican	AWPE	H	20%	6.2	247	40
				Double crested cormorant	DCCO	H	20%	6.8	273	40
Half ponded, half emergent vegetation	200	1378	0%	***Least Bittern***	LEBI	M	70%	6.8	955	140
				Virginia Rail	VIRA	L	10%	7.2	145	20
				Sora	SORA	L	10%	6.7	134	20
				Common Gallinule	COGA	L	10%	7.2	145	20
Total	***800***	***5,162***	***0%***						***5,162***	

Water Demand Summary Plots



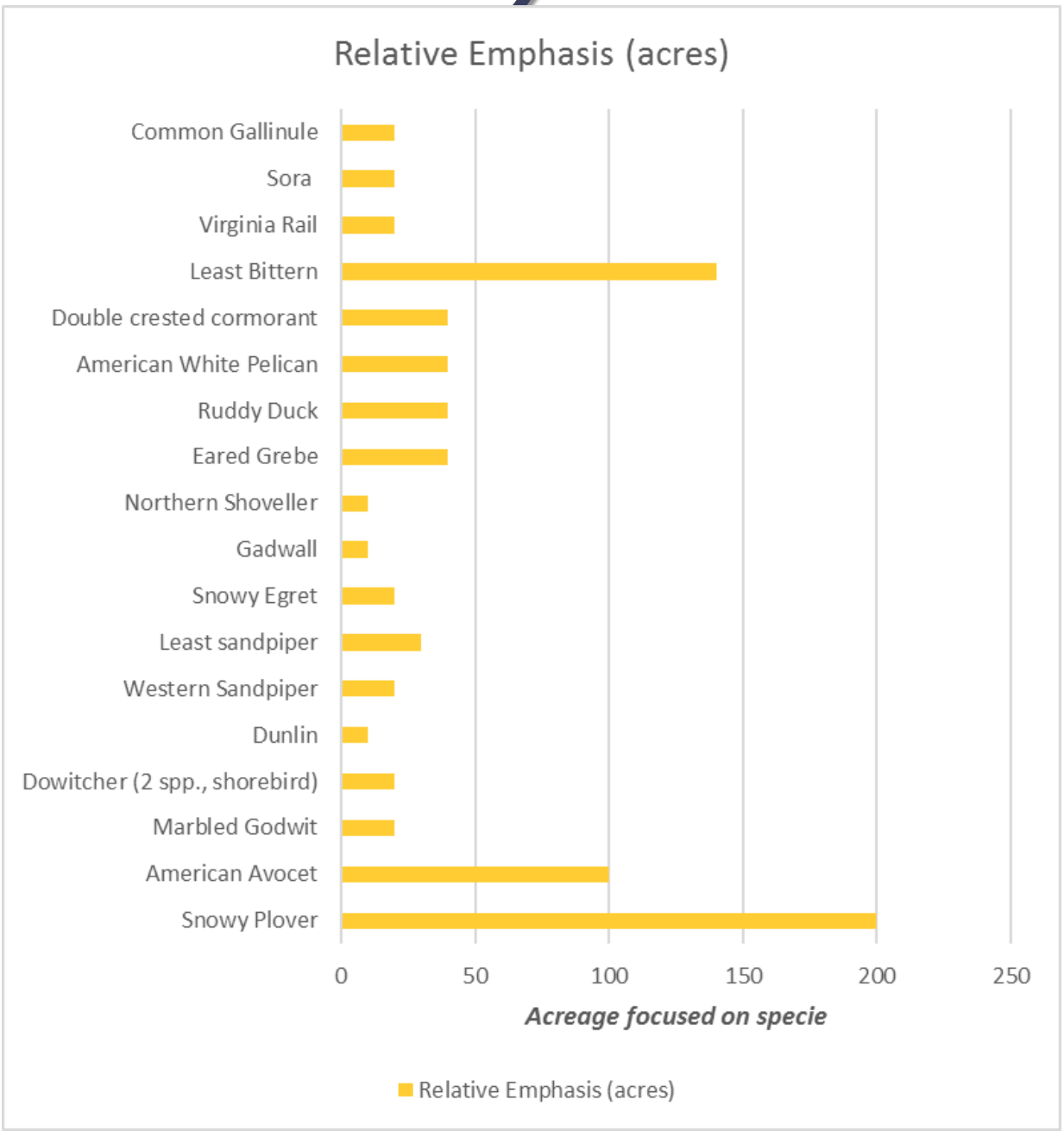






Water Demand Summary Plots

	Salinity (dS/m)	
Species	Inflow	Interior
SNPL	10	30
AMAV	10	30
MAGO	10	30
DOWI	10	30
DUNL	10	30
WESA	10	30
LESA	10	30
SNEG	10	30
GADW	10	25
NOSH	10	25
EAGR	10	30
RUDU	5	15
AWPE	5	15
DCCO	5	15
LEBI	2	8
VIRA	2	8
SORA	2	8
COGA	2	8



Water Demand Summary Plots

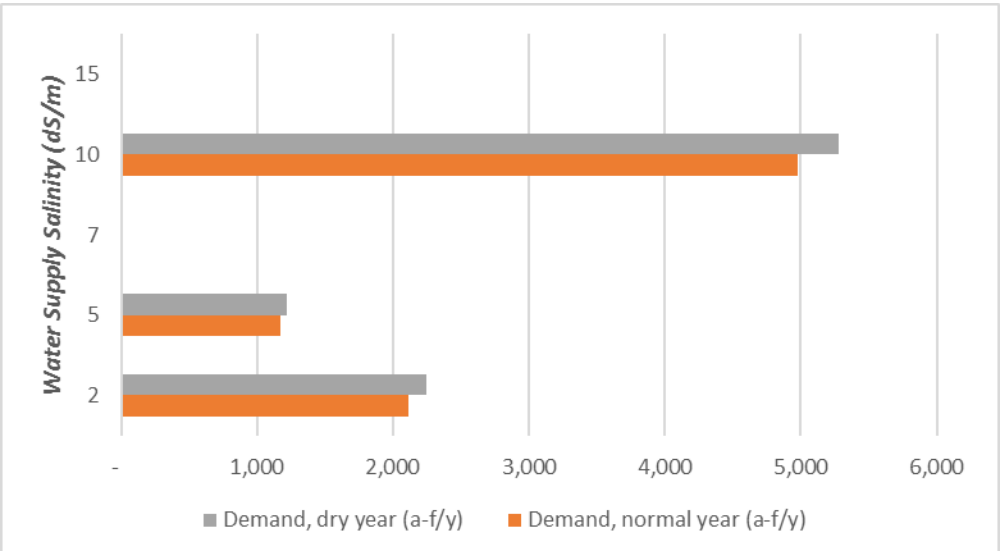
% mixing assumptions		
Min	***Max***	***Acres***
0%	25%	0
25%	50%	0
50%	75%	800
75%	100%	0

Summary of water demands[1]		
Component	***Mean year*** [2]	***Dry year*** [3]
	(acre-feet/year)	
Consumptive	5,162	5,498
Throughflow	2,151	2,291
Vertical seepage	567	567
Horizontal seepage	385	385
Total	8,265	8,741

[1]50% effective precipitation for vegetation & saturated soil, 100% for ponds

[2]Mean ET, mean precipitation

[3]95th percentile ET, 25th percentile precipitation



Questions for the future (my list)

- Species priorities
- Anticipated productivity and scale
- Sources of water
- Managing salt and selenium
- Siting
- Operational plans to, for example, achieve target salinity goals

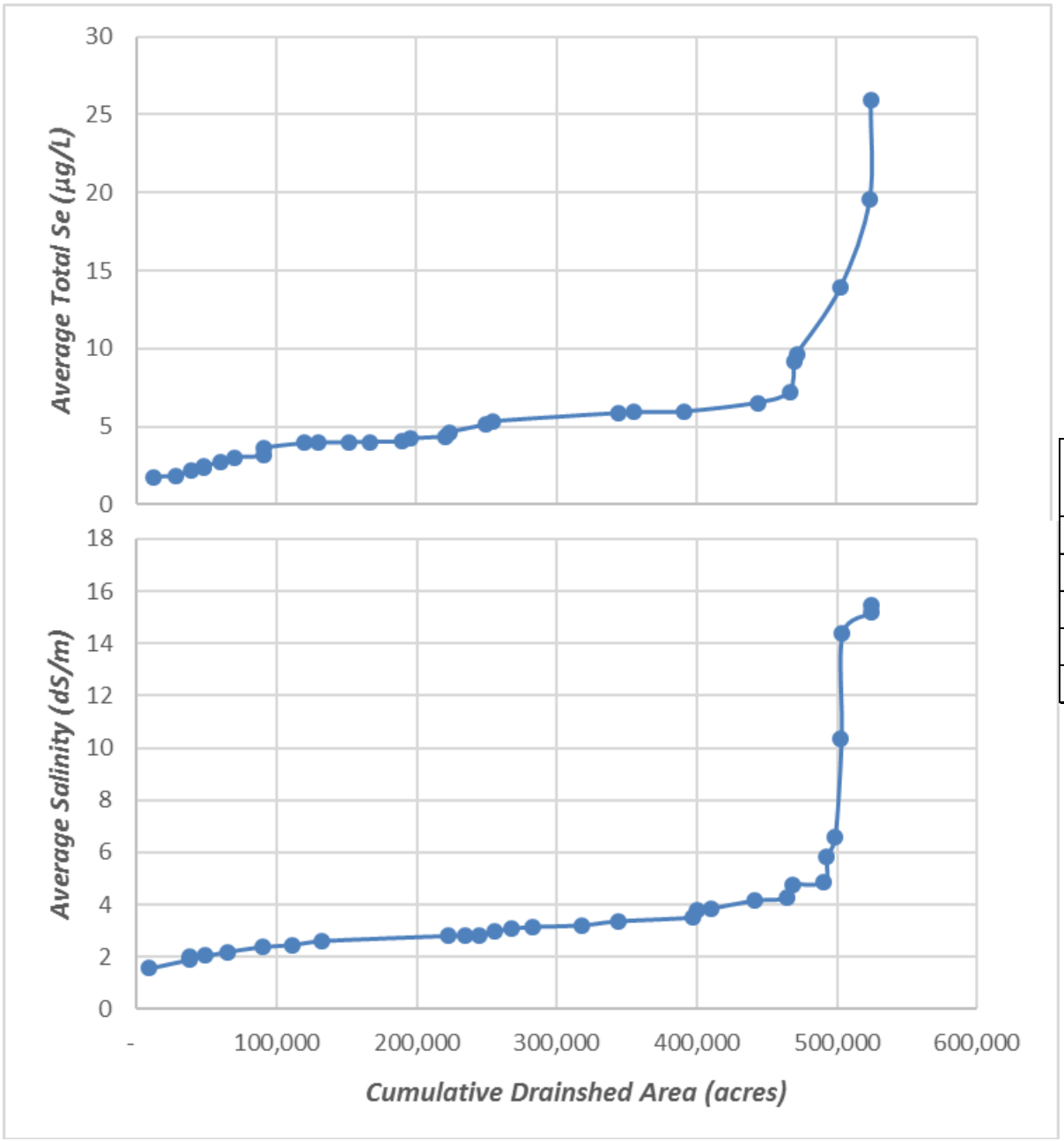
Species with Preliminary Prioritization Framework (priority not used in water demand analysis)

While eventual priorities may differ, this is an essential step in planning habitat facilities

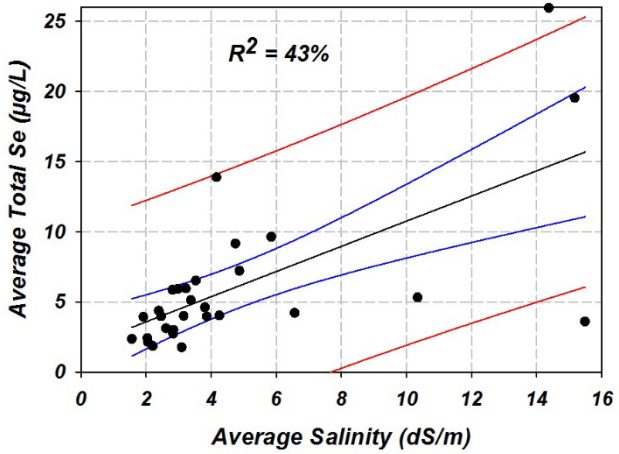
Some sort of rational framework is needed

Habitat type		Common name	Dispersed/ concentrated at SS	Fish dependent	Breeding	Shorebird	Vulnerable due to projected changes	Threatened	Priority based on past conditions, future outlook
Playa with water	SNPL	Snowy Plover	Concentrated		x	x	L		M
60 to 70% ponded, with some emergent vegetation, shutdown May-June	AMAV	American Avocet			x	x	L		M
	MAGO	Marbled Godwit				x	L		L/M
	DOWI	Dowitcher (2 spp., shorebird)				x	L		L/M
	DUNL	Dunlin				x	L		L
	WESA	Western Sandpiper				x	L		L/M
	LESA	Least sandpiper				x	L		L/M
Mostly ponded, winter-spring	SNEG	Snowy Egret		x	x				M
	GADW	Gadwall							L
	NOSH	Northern Shoveller							L/M
	EAGR	Eared Grebe	Concentrated						H
	RUDU	Ruddy Duck	Concentrated						H
	AWPE	American White Pelican	Concentrated	x					H
	DCCO	Double crested cormorant	Concentrated	x					H
Half ponded, half emergent vegetation	LEBI	Least Bittern							M
	VIRA	Virginia Rail							L
	SORA	Sora							L
	COGA	Common Gallinule							L

Water Quality



Source	Salinity (mg/L)	Selenium (µg/L)
Salton Sea	61,276	1.6
Alamo River	1,800	4.5
New River	2,200	2.3
Whitewater	1,500	1.8
Direct drains	1,200-2,500	2-6



Ecotoxicity notes

- Consider where and when species breed, and when they go through vitellogenesis, which is the key period when the selenium accumulates in the egg. For birds that breed more than about 4 weeks after leaving the imperial Valley, the exposure may not be an issue because Se has a half-life of about 3 weeks in their bodies.
- Residents & species that breed in the Valley could be exposed at a critical time, and might point to risk factors to examine and control.
- The SSMP targets salinities of 20-40 g/L TDS (26-48 dS/m). The most recent draft SSMP 10-Y Plan (from March 2017) states: "The current selenium bioaccumulation mitigation process is to maintain salinity of the various habitat types at a level that precludes or significantly reduces the growth of vegetation within the habitat areas. The SSMP planning process will evaluate the existing areas and the potential for developing additional areas." (p. 14)
- Although selenium may be a concern in some areas or situations, it does not appear to be a big issue at SSNWR, Wister, or other Imperial Valley wetlands.

Site-specific, Monthly Pond Water & Salt Balance -- Inputs

T16 monthly pond water and salt balance					
Enter starting point	2018	Year			
C0	1	mS/cm	Inflow concentration		
	0.1	dS/m			
	71	mg/L TDS			
Month	3	Mar			
Days	31				
Percent mixing	61%	of pond volume mixed with inflow			
Precip scenario	0.05				
Add Evap	0	in/mo	**Quick outlet salinity correction:**		
Add Precip	0	in/mo	16-2 outlet EC:	80	ms/cm
Precip	0.05	in/mo	% fully mixed:	84%	
Ref ET	4.10	in/mo	Final 16-2 EC:	16	ms/cm
Evap	4.10	in/mo	Final 16-3 EC:	47	ms/cm
Ep	4.05	in/mo	Final 16-4 EC:	16	ms/cm

User-supplied values

Provisional values pending input

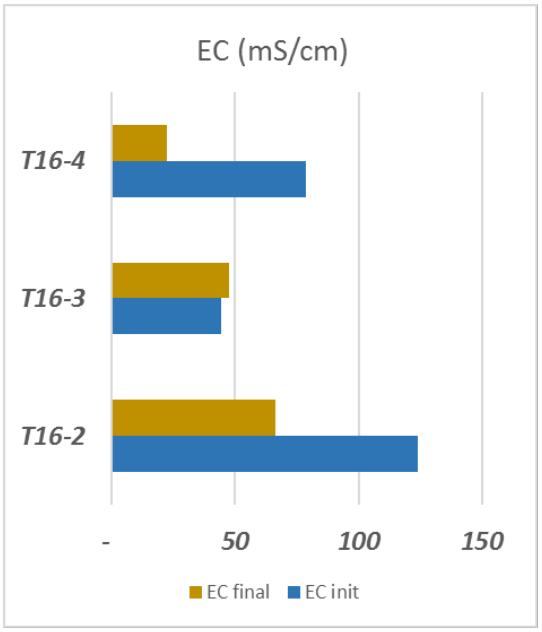
Not average, but re-calculated from total masses and volumes

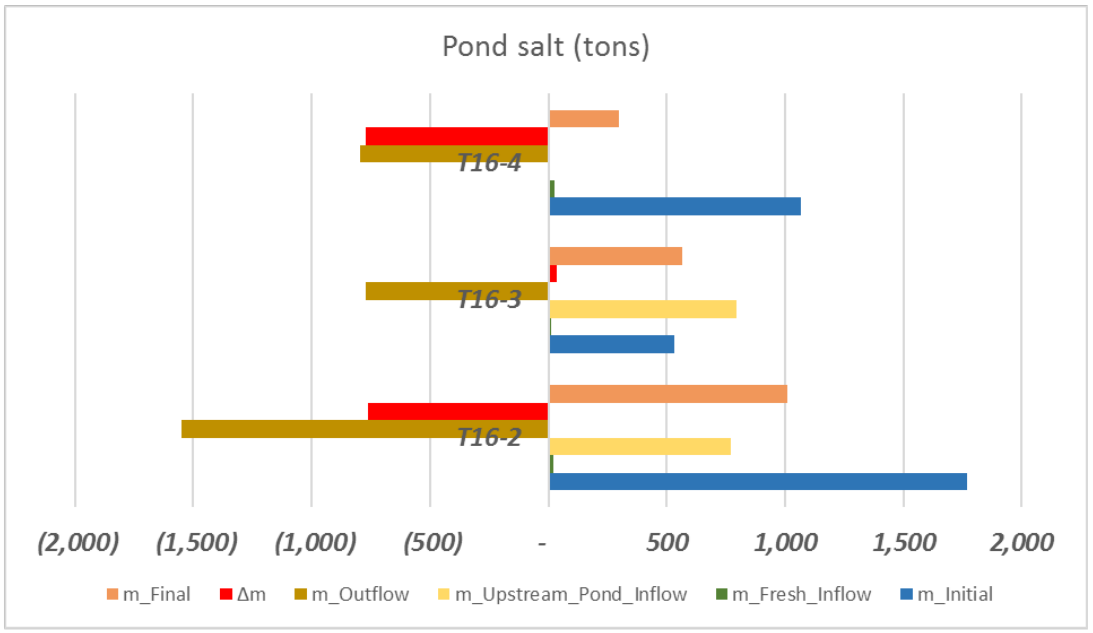
C0 is the salt concentration of new water inflow (likely from the mainline).

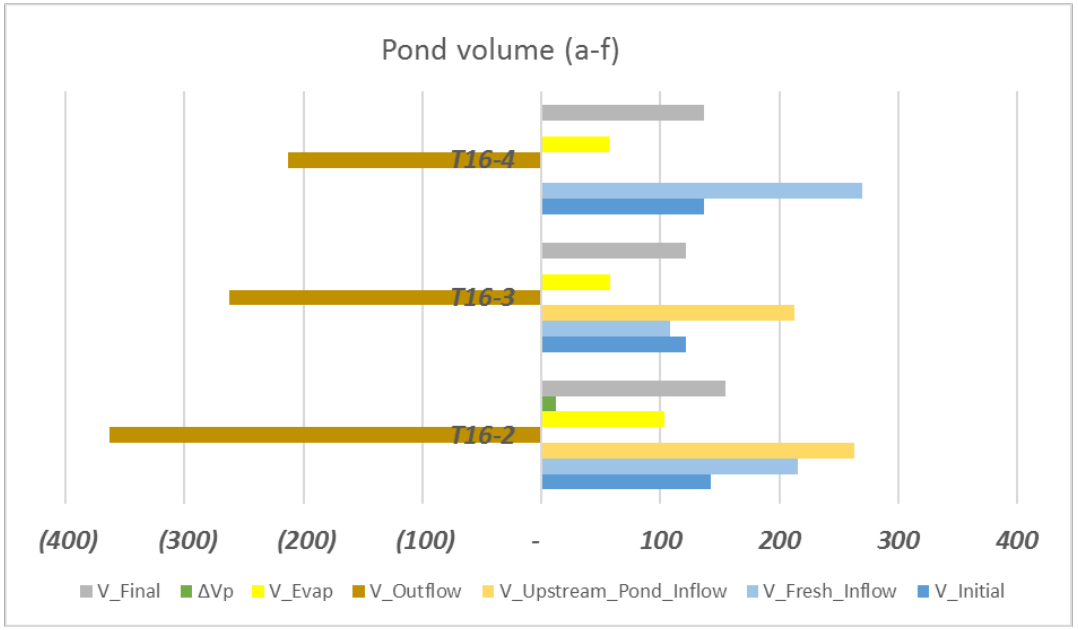
Percent mixing is mixing efficiency. Lower mixing efficiency results in less salt removal per unit inflow and outflow volume. This results from freshwater "shortcutting" from inlets to the brine sump. This can be used as a calibration parameter. Unmixed volume is not affected by dilution by inflow, and may not achieve target concentrations.

Precipitation scenarios of 5, 25, 50 (median), 75, and 95th percentiles, or average, can be selected.
Add Evap adds evaporation depth to the long-term average for the month.
Add Precip adds precipitation to the scenario selected.

Site-specific , Monthly Pond Water & Salt Balance -- Results







Questions, discussion